JAN MCLIN CLAYBERG
PATENT AND TECHNICAL TRANSLATION

JAN McLIN CLAYBERG*
OLAF BEXHOEFT**

CERTIFIED BY AMERICAN TRANSLATORS ASSOCIATION
*GERMAN AND FRENCH TO ENGLISH
**ENGLISH TO GERMAN

5316 LITTLE FALLS ROAD
ARLINGTON, VIRGINIA 22207

TELEPHONE (703) 533-0333
FACSIMILE (703) 533-0334
JANCLAYBERG@YAHOO.COM

June 20, 2006

DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/EP2005/050108, 01/12/2005, and published on 07/28/2005 under No. WO 2005/068334 A1.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

Olaf Bexhoeft

Olaf Bexhoeft

Specification

Folding Appliances

The invention relates to folding apparatuses in accordance with the preamble of claim 1 or 2.

In connection with the further processing of web-shaped goods, a basic differentiation is made between folding apparatuses with spur needle cylinder or with gripper cylinders. The folding apparatus is appropriately constructed as a function of customer requests and/or the product to be created. Based on below listed properties in connection with the use of gripper cylinders, considerable differences arise as a rule in the creation of the same product size, such as, for example, in the cylinder size, in the position of the cylinders in respect to each other and therefore in the embodiment of the frame, the drive geometry of the drive train, and many others. In connection with the construction of the folding apparatus, this has required up to now a restriction to a type, as well as dual construction of the same folding apparatus format of both types.

A spur needle cylinder has spur needles - in particular retractable - on its circumference, which pick up the continuous web which, following further conveyance, is transversely cut into a section. The section which follows is grasped by the spur needles following on the circumference and is cut in the same way. No section is required between the sections following each other on the circumference, so that the spur needle cylinder can have the same circumferential velocity as the conveying speed of the continuous web. Spur needle cylinders and subsequent cylinders -

for example folding jaw cylinders - can have the same circumference.

A gripper cylinder has one or several grippers on its shell face, which are movable between a position in which they maintain a leading end of a flat material which is to be conveyed on the gripper cylinder pressed against the shell face, and a release position in which the flat material can again be detached from the cylinder, or a new piece of flat material can be picked up and clamped. The grippers generally perform a pivot movement between these two positions. Since the amounts of time available for clamping or releasing a product are short, the pivot movement must be at high speed, and the movement amplitude between the clamping position and the release position of the gripper should be as short as possible in order to keep accelerations which stress the material within limits.

In order to prevent damage by a gripper to a trailing end of a piece of flat material which is maintained on the cylinder because of the movement of a gripper which follows on the cylinder in the circumferential direction in the course of clamping a following piece of flat material, most gripper cylinders are designed for receiving pieces of flat material which are supplied to the gripper cylinder separated from each other, so that the pieces of flat material come to rest on the gripper cylinder while forming a gap between successive pieces and the gripper can move in the gap without touching the respectively previous piece. If these pieces of flat material had previously been produced by being cut off a continuous web, it is necessary for creating such a gap to accelerate the cut-off pieces to a speed which is greater than that of the continuous web prior to cutting. But if a conveying system which conveys the products cut off the continuous

web after they have been cut runs faster than the conveyed continuous web, this leads to slippage and therefore to friction between the conveying system and a leading section of the continuous web entering it, which necessarily still moves at the original speed of the continuous web prior to the cut-off. In case of flat material with a sensitive surface, such as freshly printed products, for example, this friction can negatively affect the quality of the surface, for example by drag marks on the imprinted material, or smearing of the ink. If the pieces of flat material are composed of a stack of sheets which are not connected with each other, the problem furthermore occurs that different friction at different sides of the stack can lead to the sheets being displaced in respect to each other and the stack being pulled apart, which makes further use of the stack considerably more difficult.

It is particularly problematical if the pieces of flat material are cut off the continuous web while they are directly in contact with the gripper cylinder, for example by means of a rotating cutter cylinder which, together with the gripper cylinder, delimits a cutting gap and severs the continuous web in cooperation with a thrust element of the gripper cylinder. So that the continuous web to be cut evenly rests against the surface of the gripper cylinder, the grippers must be capable of dipping into the interior of the gripper cylinder. After a piece of flat material has been cut off the continuous web supplied, there is only very little time available for grasping the newly created leading edge of the continuous web by means of a gripper and to press it against the surface of the cylinder. However, the path between the retracted position of the gripper and the extended position, in which the flat piece of material is pressed against

the cylinder, is long and requires a high speed of the gripper movement, which can only be realized with a high-quality expensive drive mechanism. Moreover, wear, and therefore the susceptibility of the drive mechanism to breakdowns, is all the greater, the higher its operating speed is.

A gripper cylinder is known from EP 0 931 748 B1 which is capable of conveying printed products cut off a supplied continuous web without precession, i.e. without a space between the printed products following each other. With this gripper cylinder, a gripper is mounted on a shaft, which is pivotably seated in the cylinder by means of a translatory mechanism which, coupled to the pivot movement, drives the gripper to perform a parallel displacement. This translatory mechanism is used to displace the gripper between its retracted position and a position where it projects past the shell face of the cylinder, from which it can be pivoted around the shaft for pressing the leading edge of a continuous web of printed products against the cylinder surface.

It is not described how the translatory mechanism is constructed, nor how the movement of the translatory mechanism is to be driven. A mechanical coupling to the rotation of the gripper cylinder would require extensive gearing. Although it would also be conceivable to provide an electrical or hydraulic drive unit for the displacement, which pivots around the shaft together with the gripper, the problem of supplying the drive energy arises here, and furthermore such a drive unit would considerably increase the moment of inertia of the gripper to be pivoted and therefore reduce the speed of movement of the gripper which can be reached.

A folding apparatus without spur needles and with a gripper cylinder is known from DE 42 29 059 A1, whose surface speed is precessed over the speed of the continuous web.

DE 197 16 625 A1 shows a folding apparatus with a spur needle cylinder, wherein the spur needle cylinder, the cutter cylinder and the pre-folding cylinder are seated in a common frame.

The object of the invention is based on producing folding apparatuses.

In accordance with the invention, the object is attained by means of the characteristics of claim 1 or 2.

It is of particular advantage that the folding apparatus is constructed independently of the type - grippers or spur needles-. A simple exchange of the first cylinder can be performed without it being necessary to alter the frame and the drive situation. For the same section length it is possible to make a selection between the two types, while maintaining the spatial arrangement of the cylinders and/or the drive elements. Until shortly before delivery, this selection can be made by the customer, or refitting can be performed in place without it being necessary to change the frame.

For shortening the movement between the retracted position and the clamping position, the instant gripper cylinder uses a translatory movement in addition to the pivot movement, the same as the gripper cylinder known from EP 0 931 748 B1, but with the difference that a mechanism driving the translatory movement is not pivotable, together with the gripper, around the pivot shaft of the latter and in this way does not increase its moment of inertia, but instead displaces the shaft of the gripper per se in the radial direction. Since the radial stroke required for

clamping the flat material on, or releasing it from the gripper cylinder is small in comparison with the required movement amplitude of the gripper in the circumferential direction, a small amplitude of the radial displacement movement suffices, which can be generated with little outlay in energy and with little stress of the mechanical components.

If the flat material to be clamped by the gripper is a stack of sheets, at the moment of clamping the stack it is desirable to avoid a movement component of the gripper in the circumferential direction, so that the stack is not subjected to shearing forces. While customarily clamping is accomplished only by a pivot movement of the gripper and therefore the exertion of a shearing force on a stack of sheets during clamping cannot be prevented, in connection with the present gripper it is preferably provided that in a final phase of the pivot movement into the clamping position the first shaft is moved radially inward.

A simple and robust method of driving the radial inward movement of the first shaft is to mount it on a first arm, which can be pivoted around a second shaft, which is fixed in place in respect to the cylinder body, so that the radial movement of the first shaft corresponds to a pivot movement of this first arm.

In the same way the pivot movement of the gripper itself customarily takes place, this pivot movement of the first arm can be driven in a simple way by a cam disk which does not rotate together with the gripper cylinder and whose shape is scanned by a lever connected with the first arm.

Preferably a coupling rod is provided for driving the pivot movement of the gripper between the retracted position and the clamping position, which is hinged on the one side on the gripper and on the other side on a second arm, which is pivotable around a

third shaft. Its pivot movement can also be driven in the manner recited above by a cam disk.

In a space-saving arrangement, the second and the third shaft are located on opposite sides of the gripper in relation to the circumferential direction of the cylinder.

Of the two arms, the first one is oriented more in the circumferential direction, and the second more in the axial direction of the cylinder body, in other words the orientation of the first arm is respectively closer to the circumferential direction than that of the second one, and that of the second one is closer to the axial direction than that of the first one.

Preferably a counter-thrust element is assigned to each gripper on the cylinder body, which is used in cooperation with a common cutter moving together with the gripper cylinder for cutting flat material conveyed by the gripper cylinder and to be grasped by the gripper.

In relation to the direction of rotation of such a gripper cylinder, the gripper is arranged upstream of the counter-thrust element assigned to it, and the surface section of the gripper cylinder against which the gripper presses cut flat material is preferably its counter-thrust element itself, whose elasticity in this way aids the cutting process, as well as the gripping.

An exemplary embodiment of the invention is represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a schematic representation of the transverse folding apparatus utilizing a gripper cylinder,

Fig. 2, an enlarged partial sectional view through the gripper cylinder, showing the gripper in its retracted position,

Fig. 3, a partial sectional view analogous to the one in Fig. 2, showing the gripper in the course of exiting the retracted position,

Fig. 4, a partial sectional view, showing the gripper in the clamping position,

Fig. 5, a partial sectional view, showing the gripper on its return into the retracted position,

Fig. 6, a schematic sectional view through a folding apparatus,

Fig. 7, a schematic sectional view of a double folding apparatus.

A greatly schematic sectional view through a folding apparatus 28 in accordance with the present invention is shown in Fig. 1. The folding apparatus 28 comprises a cylinder 01, for example a gripper cylinder 01 which, in the example represented here, is equipped with respectively five grippers 02 and folding blades 03 evenly distributed in the circumferential direction. The gripper cylinder 01, together with a cutter cylinder 04, in this case with two cutters 06, constitutes a cutting gap 09, in which a supplied flat material 07, for example a continuous web 07, which generally is put together from a plurality of imprinted webs of material put on top of each other, for example paper webs, is separated into individual flat materials 08, for example individual printed products 08 or printed sections 08 (sections 08, for short), each of a length L corresponding to a printed page. The length L can also correspond to more than one printed page if, for example, further processing takes place, such as a further transverse fold, for example.

During the passage through the cutting gap 09, the grippers 02 and the folding blades 03 are retracted into the interior of

the gripper cylinder 01. The circumferential speed of the gripper cylinder 01 corresponds exactly to the feeding speed of the continuous web 07, so that the printed products 08 cut off the continuous web 07 follow each other without gaps on the circumference of the gripper cylinder.

Following the passage through the cutting gap 09, the grippers 02 are respectively extended out of the gripper cylinder 01 underneath the trailing section 11 of one of the printed products 08 and are pivoted opposite the direction of rotation of the cylinder in order to respectively clamp the leading edge 12 of the continuous web 07 in place against the surface of the gripper cylinder 01. Therefore the trailing sections 11 of each printed product 08 are spread away some distance from the surface of the gripper cylinder 01, but this does not hamper the even winding of the continuous web 07 on the gripper cylinder 01, because they are only spread out after being cut off the gripper cylinder 01.

The gripper cylinder 01 forms a folding gap 13 with a second cylinder 14, for example a folding jaw cylinder 14. In the course of the passage through the folding gap 13, the folding blades 03 extend from the gripper cylinder 01 in order to insert the printed products 08 along a center line into folding jaws (not represented) of the folding jaw cylinder 14. The printed products 08 transversely folded in this way are further conveyed by the folding jaw cylinder 14 as far as a location where they are transferred to a paddle wheel (not represented) for deposit onto a conveyor belt.

Fig. 2 shows a gripper 02 and its surroundings in a partial cross section transversely in respect to the axis of the gripper cylinder. The gripper 02 comprises a support beam 16 extending over the entire usable width of the gripper cylinder 01, which

has, on a radially outward directed side, a double-L or double-Z profiled element 17 made of an elastic material, such as spring steel, for example, which can be extended for clamping the printed products 08. The profiled element 17 can continuously extend in the axial direction of the gripper cylinder 01, or can be divided into a plurality of tines spaced apart in the axial direction, each of which extends through an opening in the shell face of the gripper cylinder 01.

On one side, the support beam 16 is hinged to a first arm 19, which is fixedly connected with a shaft 21, which is rotatably seated in the gripper cylinder 01. The first arm 19 extends approximately parallel in respect to the shell face of the gripper cylinder 01. The support beam 16 is furthermore hinged to a coupling rod 22, which is also aligned approximately parallel in respect to the shell face of the gripper cylinder 01 and itself is hinged on an approximately radially oriented second arm 23. This second arm 23 is fixedly connected with a shaft 24, which is rotatably seated in the gripper cylinder 01. The rotated position of the two arms 19, 23 is fixed in a manner known per se and not represented in Fig. 2 by means of two cam disks, which do not rotate together with the gripper cylinder 01 and which are traced by an arm, which is connected with the shaft 21 or 24, but not represented.

It can be easily understood by means of Fig. 2 that a rotation of the arm 19 around the shaft 21 substantially causes a radial inward or outward movement of the gripper 02, and to a lesser extent at most a pivot movement of the gripper 02 around the shaft 27 by which the support beam 16 and the first arm 19 are hinged to each other. But - assuming the shaft 21 is fixed - a

rotation of the shaft 24 would drive a pivot movement of the gripper 02 around the shaft 27.

The gripper cylinder 01 partially shown in Fig. 2 rotates in a counterclockwise direction. In the clockwise direction behind the opening of the cylinder shell containing the profiled element 17, a hard rubber strip has been inserted into it, the surface section 26, which, for example, is used as a counter-thrust element strip 26 for the cutter 06 of the cutter cylinder 04 when cutting the continuous web 07. In the configuration represented in Fig. 2, in which the gripper 02 is retracted into the interior of the gripper cylinder 01, the gripper 02 can pass the cutting gap 09, in the course of which the continuous web 07 (not represented in Fig. 2) is severed at the level of the counter-thrust element strip 26. The gripper 02 is extended out of the gripper cylinder 01 for grasping the leading edge 12 of the continuous web 07 being created in the course of this and for pressing it against the counter-thrust element strip 26.

Fig. 3 shows an intermediate position during the extension. It is possible to see that the shaft 21 has clearly been rotated in a counterclockwise direction between the configurations of Figs. 2 and 3, because of which the shaft 27 was radially outwardly displaced and the profiled element 17 of the gripper 02 has emerged from the opening of the cylinder shell. Moreover, the gripper 02 is pivoted in a clockwise direction around the shaft 27 by a slight rotation of the shaft 24 in a clockwise direction, so that the tip of the free leg 18 of the profiled element 17 lies radially above the counter-thrust element strip 26.

As represented in Fig. 4, the shaft 27 of the gripper 02 is again radially displaced into the interior of the gripper cylinder 01 by means of a rotation of the shaft 21 in a clockwise

direction, so that the free end of the profiled element 17 is lowered onto the counter-thrust element strip 26 and in the process clamps the leading end of the continuous web 07 located between it and the counter-thrust element strip 26 (not represented in Fig. 3).

After the passage of the gripper 02 through the folding gap 13, the gripper 02 is again raised by means of a rotation of the shaft 21 in a counterclockwise direction, and the printed product 08 clamped between the free end and the counter-thrust element strip 26 is released as shown in Fig. 5 (shown without the printed product 08). The shaft 24 is pivoted from this state in a counterclockwise direction in order to pull the free leg 18 of the gripper 02 past the counter-thrust element strip 26 and over the opening of the cylinder shell. By means of a subsequent rotation of the shaft 21 in a clockwise direction, the gripper 02 is again pulled back into the interior of the gripper cylinder 01 into the position shown in Fig. 2. Now the gripper 02 is ready for another passage through the cutting gap 09.

As can be seen, a small pivot angle of the gripper 02 is sufficient for being able to move it between the clamping position and the retracted position, and the radial travel is also limited - depending on the thickness of the printed product 08 to be processed - to a few millimeters. Since the gripper 02 can be simply constructed, its weight and moment of inertia are slight. The short strokes between the retracted position and the clamping position of the gripper 02 require low accelerations and therefore moderate driving forces which are easy on the material.

Particularly advantageous embodiments of a variable folding apparatus 28 are represented in what follows. The same as already shown in Fig. 1, the folding apparatus 28 has a first cylinder 01,

here initially generally called a folding blade cylinder 01, and a second cylinder 14, a folding jaw cylinder 14. As only schematically shown in section in Fig. 6, the cylinders 01, 14 are seated in a common frame 29 and are driven by at least one drive motor 31. For example, driving takes place from the drive motor 31 via a gear, or also axially directly to the first cylinder 01 and from there via a schematically indicated drive connection 33 (for example gear wheels) to the second cylinder 14.

The folding apparatus 28 is now designed in such a way that in one embodiment it is equipped with a first cylinder 01 designed as gripper cylinder 01, and in a second embodiment with one designed as spur needle cylinder 32, wherein this gripper cylinder 01 and this spur needle cylinder 32 are designed for receiving the same section lengths. The selectively employed gripper cylinder 01 has the same circumference as the folding jaw cylinder 14 working together with it. The same applies to the selectively employed spur needle cylinder 32. The sections, or cut-off printed products 08, which follow each other on the circumference, are arranged on the folding jaw cylinder 14 without being spaced apart from each other, which is accomplished, for example, by the use of the above represented embodiment of the gripper mechanism. The spur needle cylinders 32, which are embodied for the same section length (= length of the cut-off printed products 08) and selectively employed, and the folding jaw cylinders 14 have the same circumference and during operations a circumferential speed corresponding to the speed of the continuous web, or of the paper.

The embodiment of the folding apparatus 28 is such that their arrangement in respect to the frame 29 is the same for the selective employment of the gripper cylinder 01 and the spur needle cylinder 32. For both embodiments the axes of rotation

R01, R32 and R14 between the first and the second cylinders 01, 32, 14 have the same distance a (with the same section format), and are preferably at the same relative distance in regard to the frame 29 in both embodiments. Preferably the embodiments and positions of the drive train 33, and/or the positions of the drive motor 31 also correspond in both embodiments. If gear wheel connections are arranged as the drive train 32 between the cylinders 01 and 14, or 32 and 14, the gear wheels of the first cylinder 01, 32 and of the second cylinder 14 have the same number of teeth.

Thus, when retaining the seating arrangement in the frame 29, the drive geometry, the transmission ratio and/or the relative position between the first cylinder 01, 32 (folding blade cylinder) and the second cylinder 14 (folding jaw cylinder 14) for the same section format, in one embodiment the first cylinder 01, 32 is designed as a spur needle cylinder 32, and in a second embodiment as gripper cylinder 01.

In a particularly advantageous embodiment in regard to little expenditure for construction and/or refitting, the distance a between the axes of rotation R01 and R04, as well as R32 and R04, between the first cylinder 01, 32 and the cutter cylinder 04 (shown in dashed lines) are the same for both embodiments. The same applies to the position and/or embodiment of a drive connection, not represented, between the first cylinder 01, 32 and the cutter cylinder 04.

In an embodiment which is not shown, but is advantageous for refitting, the frame 29 has a recess on at least one front face of the first cylinder 01, 32, which makes the removal and/or installation of the first cylinder 01, 32 from the side possible. In this case this recess can be of such dimensions, for example,

that the cylinder 01, 32 is passed through and during operations this recess is closed by a bearing receiving the journal and, if provided, a ring surrounding the latter. For both types of equipping with the first cylinder 01, 32, a frame 29 is for example provided with identical bores for receiving bearings for the two types of cylinders 01, 32.

For the embodiment as spur needle cylinder 32, as well as the embodiment as gripper cylinder 01, the circumference of the first cylinder 01, 32 substantially corresponds to a whole number multiple of the length L of the product sections 08 to be processed. This means that also in the embodiment as gripper cylinder 01 there are no gaps between the product sections 08 received on the gripper cylinder 01 (or no precession in respect to the continuous web).

The grippers 02 assigned to a defined product section 08 are arranged, viewed in the direction of rotation of the gripper cylinder 01, upstream of the associated counter-thrust element strip 26, i.e. the grippers 02 pass through the cutting gap 09 shortly ahead of the counter-thrust element strip 26.

For example, there are a first and a second folding apparatus 28, each with at least one cylinder 01, 32, a second cylinder 14 embodied as folding jaw cylinder 14, and a cutter cylinder 04, by means of which product sections 08 of a defined length L can be cut from a continuous web 07. In both folding apparatuses 28, or embodiments, the first cylinder 01, 32 and the second cylinder 14 are seated in a common frame 29. Now the first folding apparatus 28 is designed with a first cylinder 32 embodied as a spur needle cylinder 32, and the second folding apparatus 28 with a first cylinder 01 embodied as a gripper cylinder 01. Both folding apparatuses 28 are designed for processing product strips

08 of the same length wherein, however, the seating arrangement for the first and second cylinders 01, 32, 14 in the frame 29, and/or a drive geometry for at least the first and second cylinders 01, 32, 14, and/or a relative position between the first cylinder 01, 32 and the second cylinder 14 in both folding apparatuses 28 is, or are, the same.

In an advantageous further development of the folding apparatus 28 represented in Fig. 7, it is designed as a double folding apparatus 28, i.e. it has two cylinder groups, each with respective first cylinders 01, 32 and respectively associated folding jaw cylinders 14, as well as cutter cylinders 04. For example, following the division of the continuous web 07, these two groups can be simultaneously charged with partial continuous webs. As explained above in connection with the single folding apparatus 28, the design of the double folding apparatus 28 in regard to its frame, the position of the cylinders, the drive train and/or the drive motor 31 is such that a selective equipping with a first cylinder 01, 32 embodied as a spur needle cylinder 32 or a gripper cylinder 01 can take place. The folding apparatus 28 - single or double - therefore need not be constructed as a whole in two embodiments, but only the first cylinder 01, 32 and, if required, only guide devices, such as web guidance devices and/or product guidance devices, need to be changed.

In a further development of the double folding apparatus 28, the latter has a further cylinder 34, at least in one cylinder group, by means of which the product can be provided with a second transverse fold.

List of Reference Symbols

| | |
|---|---|
| 01 | Cylinder, first, gripper cylinder, folding blade cylinder |
| 02 | Gripper |
| 03 | Folding blade |
| 04 | Cutter cylinder |
| 05 | - |
| 06 | Cutter |
| 07 | Flat material, continuous web, section |
| 08 | Flat material, printed product |
| 09 | Cutting gap |
| 10 | - |
| 11 | Section, trailing |
| 12 | Edge, leading |
| 13 | Folding gap |
| 14 | Cylinder, second, folding jaw cylinder |
| 15 | - |
| 16 | Support beam |
| 17 | Profiled element |
| 18 | Leg |
| 19 | Arm |
| 20 | - |
| 21 | Shaft |
| 22 | Coupling rod |
| 23 | Arm |
| 24 | Shaft |
| 25 | - |
| 26 | Surface section, counter-thrust element strip |

| | |
|---|---|
| 27 | Shaft |
| 28 | Folding apparatus, double folding apparatus |
| 29 | Frame |
| 30 | - |
| 31 | Drive motor |
| 32 | Cylinder, first, spur needle cylinder |
| 33 | Drive connection |
| 34 | Cylinder (second transverse folding) |
| a | Distance |
| R01 | Axis of rotation |
| R04 | Axis of rotation |
| R14 | Axis of rotation |
| R32 | Axis of rotation |